FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
112740-204	09/913579

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/00275	1 February 2000	11 February 1999

TITLE OF INVENTION

METHOD AND APPARATUS FOR CONTROLLING THE POWER OF A TRANSMIT AMPLIFIER

APPLICANT(S) FOR DO/EO/US

Rainer Eckert et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☒ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Return Receipt Postcard.

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/913579	PCT/DE00/00275	112740-204

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		CALCULATIONS PTO USE ONLY
☒ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1,000.00	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO	$860.00	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00	
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00	
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =		$1,000.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	4 - 20 =	0	x $18.00	$0.00
Independent claims	2 - 3 =	0	x $80.00	$0.00
Multiple Dependent Claims **(check if applicable)**.			☐	$0.00
TOTAL OF ABOVE CALCULATIONS			=	$1,000.00
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**.			☐	$0.00
SUBTOTAL			=	$1,000.00
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	$0.00
TOTAL NATIONAL FEE			=	$1,000.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			☒	$40.00
TOTAL FEES ENCLOSED			=	$1,040.00
			Amount to be: refunded	$
			charged	$

☒ A check in the amount of **$1,040.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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P.O. Box 1135
Chicago, Illinois 60690-1135
Telephone (312) 807-4292

SIGNATURE

William E. Vaughan
NAME

39,056
REGISTRATION NUMBER

August 13, 2001
DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANT:	Rainer Eckert et. al	DOCKET NO: 112740-204
SERIAL NO:		GROUP ART UNIT:
		EXAMINER:
INTERNATIONAL APPLICATION NO:		PCT/DE00/00275
INTERNATIONAL FILING DATE:		1 February 2000
INVENTION:	METHOD AND APPARATUS FOR CONTROLLING THE POWER OF A TRANSMIT AMPLIFIER	

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification:

SPECIFICATION

TITLE OF INVENTION

METHOD AND APPARATUS FOR CONTROLLING THE POWER OF A TRANSMIT AMPLIFIER

BACKGROUND OF THE INVENTION

The present invention relates to a method and an apparatus for controlling the power of a transmit amplifier; in particular, a transmit amplifier in a mobile radio terminal.

Figure 2 shows an outline circuit diagram of a conventional arrangement for controlling the power of a transmit amplifier PA. The signals sig which are supplied to the transmit amplifier PA to be amplified are amplified on the basis of a control parameter reg, which is supplied to the transmit amplifier PA and represents a measure of the gain or the gain factor, and are supplied to a directional coupler RK. The directional coupler RK outputs a small proportion of the power supplied from the transmit amplifier PA to the antenna ANT, and supplies this to a radio-frequency detector HFD, which converts this power to a DC voltage. This DC voltage value produced in this way is supplied as the actual value act to a comparison device V, where it is compared with a nominal value NOM which is preset by a control device, such as a microcontroller for a mobile radio terminal. The result of the comparison is output as a control parameter reg which adjusts the gain of the transmit amplifier PA such that the actual value corresponds to the nominal value nom. For this purpose, the gain factor is raised or lowered depending on the difference between the nominal value and the actual value. The majority of the power is supplied from the directional coupler RK to the antenna ANT, from where this power is transmitted in the form of radio-frequency signals.

EP-0388894 discloses the reception, at the receiving end, of a portion of the power which is transmitted from an antenna of a mobile radio terminal at the transmission end. This results in the disadvantage that the power control process includes a base station and, thus, the network infrastructure. This leads to slow control with inertia as well as to additional signaling complexity between the base station and the network infrastructure. As a result, this can be used only in mobile radio terminals which are operated in a mobile radio system which supports this type of power control.

Every effort is being made throughout the world to develop mobile radio terminals which are as small and light as possible. The use of a directional coupler is not consistent with this aim, since it is relatively large, heavy and complex to produce.

The present invention is, thus, directed toward a method and an apparatus for controlling the power of a transmit amplifier which allow the power to be controlled both easily and reliably and, in particular, without using a directional coupler.

SUMMARY OF THE INVENTION

According to the present invention, a portion of the power transmitted from an antenna is received and, in turn used to control the power of the transmit amplifier.

The present invention is thus based on the idea that a portion of the power transmitted from the transmit amplifier is not output through a directional coupler, with this portion of the power being used, after further processing, to control the power of the transmit amplifier. Indeed, the present invention concerns supplying essentially all the power transmitted from the transmit amplifier to the antenna of a mobile radio terminal, transmitting this power via the antenna at the transmission end, and receiving a portion of the transmitted power at the transmission end, with this portion of the transmitted power being supplied, possibly after further processing, to the transmit amplifier in order to control its power.

This has the advantage that there is no need for the complex use of a directional coupler and the power can be controlled more accurately. This is because the actually transmitted power, or a portion of it, is used to control the power and not, as is normal in the prior art, a portion of the power which is supplied to the antenna prior to being transmitted.

A development of the present invention provides for an antenna and the part for receiving the transmitted power to be arranged on a base, which allows the arrangement for power control to be produced in an even simpler manner, particularly if the part for receiving the transmitted power and the antenna are produced as a planar or patch antenna. The part for receiving a portion of the power transmitted from an antenna, for the purposes of the present application, may include an antenna or parts of an antenna, such as a resonator.

Additional features and advantages of the present invention are described in, and will be apparent from, the following detailed description and the figures.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows an outline circuit diagram of an apparatus for controlling the power of a transmit amplifier in accordance with the teachings of the present invention;

Figure 2 shows an outline circuit diagram of a conventional arrangement for controlling the power of a transmit amplifier;

Figure 3 shows a schematic cross-sectional illustration of a planar antenna and of a planar coupling element;

Figure 4 shows a schematic illustration of planar antennas having a coupling element on a substrate; and

Figure 5 shows an outline circuit diagram of an alternative embodiment of the apparatus for controlling the power of a transmit amplifier of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an antenna ANT which transmits radio-frequency signals at a power level governed by the gain of a transmit amplifier PA. A coupling element K, which can be produced based on the same principle as an antenna, is dimensioned and arranged in such a manner that it receives a small proportion of the power transmitted from the antenna ANT. Thus, it outputs a portion of the power transmitted from the antenna ANT. This portion (which is received by the coupling element K) of the power transmitted by the antenna ANT is converted by a radio frequency detector HFD to a DC voltage value, which thus represents a measure of the power transmitted by the antenna ANT. This DC voltage value is supplied as the actual value to a comparison device V, such as a comparator circuit. This actual value is compared in the comparison device V with a nominal value nom, which is preset by a control device such as the microcontroller of a mobile radio terminal, for power control. Depending on the comparison result, the comparison device V transmits a control parameter reg, which adjusts the gain factor of the transmit amplifier PA such that the signals sig to be amplified are transmitted from the antenna ANT at a power level such that the actual value act corresponds to the nominal value nom. This is done by raising or lowering the gain factor depending on the difference between the nominal and actual values.

In order to illustrate the exemplary embodiments clearly, the drawings do not illustrate antenna switches, diplexers, or duplexers.

The principle of a planar antenna or patch antenna can be used for the antenna ANT and/or the coupling element K. Figure 3 shows a sectional illustration of such a planar antenna or patch antenna including a coupling device ANK, a ground surface M, an insulated (for example, ceramic) substrate SUB, a resonator RES and a short

circuit KU between the resonator RES and the ground surface M. The double arrow indicates the polarization direction POL of such a patch antenna. The signals also can be coupled in a different way to that illustrated; for example capacitively. The radio-frequency supply or coupling may be in the form of a coaxial inner conductor.

Figure 4 shows an antenna arrangement which, in an appropriate manner for transmission and reception operation, includes two antennas ANT1, ANT2, which are arranged on a base, such as a board or a substrate SUB, with appropriate coupling devices ANK1, ANK2, resonators RES1, RES2 and short circuits (which are not illustrated) between the ground surface and the resonators. The amplified radio-frequency signals are supplied from the transmit amplifier PA to the transmit antenna ANT1 via the coupling device ANK1. The signals received by the correspondingly designed receiving antenna ANT2 are supplied via the coupling device ANK2 to a receive amplifier. The coupling element K may be provided either on another substrate or, as illustrated by way of example in this drawing, on the same substrate SUB, likewise based on the principle of a planar antenna or patch antenna. In this case, the coupling element K likewise has a resonator RES3 and a coupling device ANK3. The coupling resonator RES3 is connected to the radio-frequency detector HFD via the feed point and/or the coupling device ANK3.

In alternative embodiments of the present invention, the various antennas also may be antennas of a dual-band antenna arrangement or multi-band antenna arrangement. This allows, for example, a mobile radio terminal to be operated in different frequency bands. Another embodiment variant provides for different antennas and/or resonators in each case to be provided for the transmit band and the receive band when using two different frequency bands, as can be achieved by mounting four resonators on a substrate for a dual-band antenna arrangement. The resonator for the coupling element K also may be in the form of a fifth resonator on the same substrate.

Figure 5 shows an antenna arrangement in which the resonator RES1 is tuned to the transmit frequency band, and the resonator RES2 is tuned to the receive frequency band. During reception, the resonator RES2 is active and the received signal is supplied via a switching device S to the receive amplifier LNA. During transmission, the resonator RES1 is active, and the resonator RES2 carries out the

function of a coupling element K, whose output signal is now supplied to the radio-frequency detector HFD once the switching device S has switched over. The switching device S may, in this case, be controlled by a control device, such as a microcontroller in the mobile radio terminal. The comparison of the actual value act and the nominal value nom, and the control of the transmit amplifier PA as a function of this, are carried out in accordance with the description relating to Figure 1. A development provides for the antenna arrangement to be a dual-band antenna arrangement, which has four resonators, with one resonator in each case being provided for transmitting and receiving in each of the two frequency bands. During transmit operation, the reception resonators are used as coupling elements. The reception resonators are switched over to the receive amplifier LNA and the radio-frequency detector HFD, as described above, by a controlled switching device.

Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

ABSTRACT OF THE DISCLOSURE

A method and apparatus for controlling the power of a transmit amplifier wherein a portion of the power transmitted from the antenna is received by a coupling element and is converted via a radio-frequency detector to a DC voltage value which is used for power control, such that there is no longer any need for complex use of a directional coupler between the transmit amplifier and the antenna.

In the claims:

On page 7, cancel line 1, and substitute the following left-hand justified heading therefor:

CLAIMS

Please cancel claims 1-4, without prejudice, and substitute the following claims therefor:

5. A method for controlling the power of a transmit amplifier of a mobile radio terminal, the method comprising the steps of:

receiving a portion of the power transmitted at a transmission end from an antenna of the mobile radio terminal at the transmission end by a coupling element of the mobile radio terminal; and

using the portion of the power transmitted to control the power of the transmit amplifier.

6. An apparatus for controlling the power of a transmit amplifier of a mobile radio terminal, comprising:

a part for receiving a portion of the power transmitted from an antenna of the mobile radio terminal; and

a part for controlling the power of the transmit amplifier as a function of the received portion of the power transmitted.

7. An apparatus for controlling the power of a transmit amplifier of a mobile radio terminal as claimed in claim 6, wherein the antenna of the mobile radio terminal is a planar antenna having a first resonator mounted on a substrate, the part for receiving a portion of the power transmitted has a second resonator, and the first and second resonators are mounted on the same substrate.

8. An apparatus for controlling the power of a transmit amplifier of a mobile radio terminal as claimed in claim 6, wherein the part for receiving a portion of the power transmitted is provided, during transmission operation of the mobile radio terminal, at least partially by a receiving antenna of the mobile radio terminal.

REMARKS

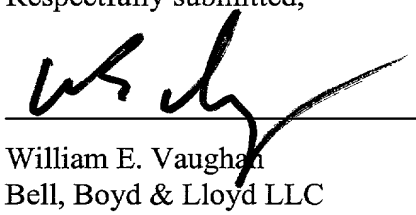
The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is added thereby. Attached hereto is a marked-up version of the changes made to the specification by the present amendment. The attached page is captioned "**Version With Markings To Show Changes Made**".

In addition, the present amendment cancels original claims 1-4 in favor of new claims 5-8. Claims 5-8 have been presented solely because the revisions by crossing out underlining which would have been necessary in claims 1-4 in order to present those claims in accordance with preferred United States Patent Practice would have

been too extensive, and thus would have been too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§103, 102, 103 or 112. Indeed, the cancellation of claims 1-4 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-4.

Early consideration on the merits is respectfully requested.

Respectfully submitted,



(Reg. No. 39,056)

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Attorneys for Applicants

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Specification:

The Specification of the present application, including the Abstract, has been amended as follows:

~~Description~~

~~Method and arrangement for controlling the power of a transmit amplifier~~

SPECIFICATION

TITLE OF INVENTION

METHOD AND APPARATUS FOR CONTROLLING THE POWER OF A TRANSMIT AMPLIFIER

BACKGROUND OF THE INVENTION

The present invention relates to a method and an apparatus ~~arrangement~~ for controlling the power of a transmit amplifier; in particular, a transmit amplifier in a mobile radio terminal.

Figure 2 shows an outline circuit diagram of a conventional arrangement for controlling the power of a transmit amplifier PA. The signals sig which are supplied to the transmit amplifier PA ~~and are~~ to be amplified are amplified on the basis of a control parameter reg, which is supplied to the transmit amplifier PA and represents a measure of the gain or the gain factor, and are supplied to a directional coupler RK. The directional coupler RK outputs a small proportion of the power supplied from the transmit amplifier PA to the antenna ANT, and supplies this to a radio-frequency detector HFD, which converts this power to a DC voltage. This DC voltage value produced in this way is supplied as the actual value act to a comparison device V, where it is compared with a nominal value NOM which is preset by a control device, such as a microcontroller for a mobile radio terminal. The result of the comparison is output as a control parameter reg which adjusts the gain of the transmit amplifier PA such that the actual value corresponds to the nominal value nom. For this purpose, the gain factor is raised or lowered depending on the difference between the nominal value and the actual value. The majority of the power is supplied from the directional coupler RK to the antenna ANT, from where this power is transmitted in the form of radio-frequency signals.

EP-0388894 discloses the reception, at the receiving end, of a portion of the power which is transmitted from an antenna of a mobile radio terminal at the transmission end. This results in the disadvantage that the power control process includes a base station and, thus, the network infrastructure. This ~~, and hence firstly~~ leads to slow control with inertia as well as ~~and second leads~~ to additional signaling complexity between the base station and the network infrastructure. As a result, this ~~, in consequence, thirdly~~ can be used only in mobile radio terminals which are operated in a mobile radio system which supports this type of power control.

Every effort is being made throughout the world to develop mobile radio terminals which are as small and light as possible. The use of a directional coupler is not consistent with this aim, since it is relatively large, heavy and complex to produce.

The present invention is, thus, directed toward ~~based on the object of specifying~~ a method and an apparatus ~~arrangement~~ for controlling the power of a transmit amplifier which allow the power to be controlled both easily and ~~nevertheless~~ reliably~~,~~ and, in particular, without using a directional coupler.

~~This object is achieved by the independent patent claims. Advantageous developments can be found in the dependent claims.~~

SUMMARY OF THE INVENTION

According to the present invention, a portion of the power transmitted from an antenna is received and, in turn, ~~is~~ used to control the power of the transmit amplifier.

The present invention is thus based on the idea that a portion of the power transmitted from the transmit amplifier is not output through a directional coupler, with this portion of the power being used, after further processing, to control the power of the transmit amplifier. Indeed, the present invention concerns ~~, but of~~ supplying essentially all the power transmitted from the transmit amplifier to the antenna of a mobile radio terminal, ~~of~~ transmitting this power via ~~by means of~~ the antenna at the transmission end, and ~~of~~ receiving a portion of the transmitted power at the transmission end, with this portion of the transmitted power being supplied, possibly after further processing, to the transmit amplifier~~,~~ in order to control its power.

This has the advantage that there is no need for the complex use of a directional coupler and the power can be controlled more accurately. This is because ~~, since~~ the

actually transmitted power, or a portion of it, is used to control the power and not, as is normal in the prior art, a portion of the power which is supplied to the antenna prior to being transmitted.

A development of the present invention provides for an antenna and the part ~~means~~ for receiving the transmitted power to be arranged on a base, which allows the arrangement for power control to be produced in an even simpler manner, particularly if the part ~~means~~ for receiving the transmitted power and the antenna are produced as a planar or patch antenna. The part ~~expression "means~~ for receiving a portion of the power transmitted from an antenna~~"~~, for the purposes of the present application, may include ~~also means~~ an antenna or parts of an antenna, such as a resonator.

~~The invention will be described in more detail in the following text with reference to preferred exemplary embodiments, which will be explained using the figures listed below:~~

Additional features and advantages of the present invention are described in, and will be apparent from, the following detailed description and the figures.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows an outline circuit diagram of an apparatus ~~arrangement~~ for controlling the power of a transmit amplifier in accordance with the teachings of the present invention;

Figure 2 shows an outline circuit diagram of a conventional arrangement for controlling the power of a transmit amplifier;

Figure 3 shows a schematic cross-sectional illustration of a planar antenna and of a planar coupling element;

Figure 4 shows a schematic illustration of planar antennas having a coupling element on a substrate; and

Figure 5 shows an outline circuit diagram of an alternative ~~one~~ embodiment ~~variant~~ of the apparatus ~~an arrangement~~ for controlling the power of a transmit amplifier of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an antenna ANT which transmits radio-frequency signals at a power level governed by the gain of a transmit amplifier PA. A coupling element K,

which can be produced based on the same principle as an antenna, is dimensioned and arranged in such a manner that it receives a small proportion of the power transmitted from the antenna ANT. Thus, it ~~, and thus~~ outputs a portion of the power transmitted from the antenna ANT. This portion (which is received by the coupling element K) of the power transmitted by the antenna ANT is converted by a radio frequency detector HFD to a DC voltage value, which thus represents a measure of the power transmitted by the antenna ANT. This DC voltage value is supplied as the actual value to a comparison device V, such as a comparator circuit. This actual value is compared in the comparison device V with a nominal value nom, which is preset by a control device such as the microcontroller of a mobile radio terminal, for power control. Depending on the comparison result, the comparison device V transmits a control parameter reg, which adjusts the gain factor of the transmit amplifier PA such that the signals sig to be amplified are transmitted from the antenna ANT at a power level such that the actual value act corresponds to the nominal value nom. This is done by raising or lowering the gain factor depending on the difference between the nominal and actual values.

In order to illustrate the exemplary embodiments clearly, the drawings do not illustrate antenna switches, diplexers, or duplexers.

The principle of a planar antenna or patch antenna can be used for the antenna ANT and/or the coupling element K. Figure 3 shows a sectional illustration of such a planar antenna or patch antenna including ~~comprising~~ a coupling device ANK, a ground surface M, an insulated~~,~~ (for example, ceramic)~~,~~ substrate SUB, a resonator RES and a short circuit KU between the resonator RES and the ground surface M. The double arrow indicates the polarization direction POL of such a patch antenna. The signals ~~can~~ also can be coupled in a different way to that illustrated~~,~~ for example capacitively. The radio-frequency supply or coupling may be in the form of a coaxial inner conductor.

Figure 4 shows an antenna arrangement which, in an appropriate manner for transmission and reception operation, includes ~~comprises~~ two antennas ANT1, ANT2, which are arranged on a base, such as a board or a substrate SUB, with appropriate coupling devices ANK1, ANK2, resonators RES1, RES2 and short circuits (which are

not illustrated) between the ground surface and the resonators. The amplified radio-frequency signals are supplied from the transmit amplifier PA to the transmit antenna ANT1 via the coupling device ANK1. The signals received by the correspondingly designed receiving antenna ANT2 are supplied via the coupling device ANK2 to a receive amplifier. The coupling element K may be provided either on another substrate or, as illustrated by way of example in this drawing, on the same substrate SUB, likewise based on the principle of a planar antenna or patch antenna. In this case, the coupling element K likewise has a resonator RES3 and a coupling device ANK3. ~~In this case, the~~ The coupling resonator RES3 is connected to the radio-frequency detector HFD via the feed point and/or the coupling device ANK3.

In alternative embodiments ~~embodiment variants~~ of the present invention, the various antennas ~~may~~ also may be antennas of a dual-band antenna arrangement or multi-band antenna arrangement. This ~~and this~~ allows, for example, a mobile radio terminal to be operated in different frequency bands. Another embodiment variant provides for different antennas and/or resonators in each case to be provided for the transmit band and the receive band when using two different frequency bands, as can be achieved by mounting four resonators on a substrate for a dual-band antenna arrangement. The resonator for the coupling element K ~~may~~ also may be in the form of a fifth resonator on the same substrate.

Figure 5 shows an antenna arrangement in which the resonator RES1 is tuned to the transmit frequency band, and the resonator RES2 is tuned to the receive frequency band. During reception, the resonator RES2 is active and the received signal is supplied via a switching device S to the receive amplifier LNA. During transmission, the resonator RES1 is active, and the resonator RES2 carries out the function of a coupling element K, whose output signal is now supplied to the radio-frequency detector HFD~~,~~ once the switching device S has switched over. The switching device S may~~,~~ in this case~~,~~ be controlled by a control device, such as a microcontroller in the mobile radio terminal. The comparison of the actual value act and the nominal value nom, and the control of the transmit amplifier PA as a function of this, are carried out in accordance with the description relating to Figure 1. A development provides for the antenna arrangement to be a dual-band antenna

arrangement, which has four resonators, with one resonator in each case being provided for transmitting and receiving in each of the two frequency bands. During transmit operation, the reception resonators are used as coupling elements. The reception resonators are switched over to the receive amplifier LNA and the radio-frequency detector HFD, as described above, by ~~means of~~ a controlled switching device.

Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

~~Abstract~~

~~Method and arrangement for controlling the power of a transmit amplifier~~

ABSTRACT OF THE DISCLOSURE

~~In order to control the power of a transmit amplifier,~~ A method and apparatus for controlling the power of a transmit amplifier wherein a portion of the power transmitted from the antenna is received by a coupling element and is converted via a radio-frequency detector to a DC voltage value which is used for power control, such that there ~~. There~~ is no longer any need for complex use of a directional coupler between the transmit amplifier and the antenna.

~~Figure 1~~

Description

Method and arrangement for controlling the power of a transmit amplifier

The invention relates to a method and an arrangement for controlling the power of a transmit amplifier, in particular a transmit amplifier in a mobile radio terminal.

Figure 2 shows an outline circuit diagram of a conventional arrangement for controlling the power of a transmit amplifier PA. The signals sig which are supplied to the transmit amplifier PA and are to be amplified are amplified on the basis of a control parameter reg, which is supplied to the transmit amplifier PA and represents a measure of the gain or the gain factor, and are supplied to a directional coupler RK. The directional coupler RK outputs a small proportion of the power supplied from the transmit amplifier PA to the antenna ANT, and supplies this to a radio-frequency detector HFD, which converts this power to a DC voltage. This DC voltage value produced in this way is supplied as the actual value act to a comparison device V, where it is compared with a nominal value NOM which is preset by a control device, such as a microcontroller for a mobile radio terminal. The result of the comparison is output as a control parameter reg which adjusts the gain of the transmit amplifier PA such that the actual value corresponds to the nominal value nom. For this purpose, the gain factor is raised or lowered depending on the difference between the nominal value and the actual value. The majority of the power is supplied from the directional coupler RK to the antenna ANT, from where this power is transmitted in the form of radio-frequency signals.

EP-0388894 discloses the reception, at the receiving end, of a portion of the power which is

transmitted from an antenna of a mobile radio terminal at the transmission end. This results in the disadvantage that the power control process includes a base station and thus the network infrastructure, and hence

firstly leads to slow control with inertia and second leads to additional signaling complexity between the base station and the network infrastructure and, in consequence, thirdly can be used only in mobile radio terminals which are operated in a mobile radio system which supports this type of power control.

Every effort is being made throughout the world to develop mobile radio terminals which are as small and light as possible. The use of a directional coupler is not consistent with this aim, since it is relatively large, heavy and complex to produce.

The invention is thus based on the object of specifying a method and an arrangement for controlling the power of a transmit amplifier which allow the power to be controlled easily and nevertheless reliably, and in particular without using a directional coupler.

This object is achieved by the independent patent claims. Advantageous developments can be found in the dependent claims.

According to the invention, a portion of the power transmitted from an antenna is received and is used to control the power of the transmit amplifier.

The invention is thus based on the idea that a portion of the power transmitted from the transmit amplifier is not output through a directional coupler, with this portion of the power being used, after further processing, to control the power of the transmit amplifier, but of supplying essentially all the power transmitted from the transmit amplifier to the antenna of a mobile radio terminal, of transmitting this power by means of the antenna at the transmission end and of receiving a portion of the transmitted power at the transmission end, with this portion of the transmitted power being supplied, possibly after further

processing, to the transmit amplifier, in order to control its power.

This has the advantage that there is no need for the complex use of a directional coupler and the power can be controlled more accurately, since the actually transmitted power, or a portion of it, is used to control the power and not, as is normal in the prior art, a portion of the power which is supplied to the antenna prior to being transmitted.

A development of the invention provides for an antenna and the means for receiving the transmitted power to be arranged on a base, which allows the arrangement for power control to be produced in an even simpler manner, particularly if the means for receiving the transmitted power and the antenna are produced as a planar or patch antenna. The expression "means for receiving a portion of the power transmitted from an antenna", for the purposes of the present application, also means an antenna or parts of an antenna, such as a resonator.

The invention will be described in more detail in the following text with reference to preferred exemplary embodiments, which will be explained using the figures listed below:

Figure 1 shows an outline circuit diagram of an arrangement for controlling the power of a transmit amplifier;

Figure 2 shows an outline circuit diagram of a conventional arrangement for controlling the power of a transmit amplifier;

Figure 3 shows a schematic cross-sectional illustration of a planar antenna and of a planar coupling element;

Figure 4 shows a schematic illustration of planar antennas having a coupling element on a substrate;

Figure 5 shows an outline circuit diagram of one embodiment variant of an arrangement for controlling the power of a transmit amplifier.

Figure 1 shows an antenna ANT which transmits radio-frequency signals at a power level governed by the gain of a transmit amplifier PA. A coupling element K, which can be produced based on the same principle as an antenna, is dimensioned and arranged in such a manner that it receives a small proportion of the power transmitted from the antenna ANT, and thus outputs a portion of the power transmitted from the antenna ANT. This portion (which is received by the coupling element K) of the power transmitted by the antenna ANT is converted by a radio-frequency detector HFD, is converted by a radio frequency detector HFD to a DC voltage value, which thus represents a measure of the power transmitted by the antenna ANT. This DC voltage value is supplied as the actual value to a comparison device V, such as a comparator circuit. This actual value is compared in the comparison device V with a nominal value nom, which is preset by a control device such as the microcontroller of a mobile radio terminal, for power control. Depending on the comparison result, the comparison device V transmits a control parameter reg, which adjusts the gain factor of the transmit amplifier PA such that the signals sig to be amplified are transmitted from the antenna ANT at a power level such that the actual value act corresponds to the nominal value nom. This is done by raising or lowering the gain factor depending on the difference between the nominal and actual values.

In order to illustrate the exemplary embodiments clearly, the drawings do not illustrate antenna switches, diplexers, or duplexers.

The principle of a planar antenna or patch antenna can be used for the antenna ANT and/or the coupling

element K. Figure 3 shows a sectional illustration of such a planar antenna or patch antenna comprising a coupling device ANK, a ground surface M, an insulated, for example ceramic, substrate SUB, a resonator RES and a short circuit KU between the resonator RES and the ground surface M. The double arrow indicates the polarization direction POL of such a patch antenna. The signals can also be coupled in a different way to that illustrated, for example capacitively. The radio-frequency supply or coupling may be in the form of a coaxial inner conductor.

Figure 4 shows an antenna arrangement which, in an appropriate manner for transmission and reception operation, comprises two antennas ANT1, ANT2, which are arranged on a base, such as a board or a substrate SUB, with appropriate coupling devices ANK1, ANK2, resonators RES1, RES2 and short circuits (which are not illustrated) between the ground surface and the resonators. The amplified radio-frequency signals are supplied from the transmit amplifier PA to the transmit antenna ANT1 via the coupling device ANK1. The signals received by the correspondingly designed receiving antenna ANT2 are supplied via the coupling device ANK2 to a receive amplifier. The coupling element K may be provided either on another substrate or, as illustrated by way of example in this drawing, on the same substrate SUB, likewise based on the principle of a planar antenna or patch antenna. In this case, the coupling element K likewise has a resonator RES3 and a coupling device ANK3. In this case, the coupling resonator RES3 is connected to the radio-frequency detector HFD via the feed point and/or the coupling device ANK3.

In embodiment variants of the invention, the various antennas may also be antennas of a dual-band antenna arrangement or multi-band antenna arrangement and this allows, for example, a mobile radio terminal to be operated in different frequency bands. Another embodiment variant provides for different antennas and/or resonators in each case to be provided for the transmit band and the receive band when using two different frequency bands, as can be achieved by mounting four resonators on a substrate for a dual-band antenna arrangement. The resonator for the coupling element K may also be in the form of a fifth resonator on the same substrate.

Figure 5 shows an antenna arrangement in which the resonator RES1 is tuned to the transmit frequency band, and the resonator RES2

is tuned to the receive frequency band. During reception, the resonator RES2 is active and the received signal is supplied via a switching device S to the receive amplifier LNA. During transmission, the resonator RES1 is active, and the resonator RES2 carries out the function of a coupling element K, whose output signal is now supplied to the radio-frequency detector HFD, once the switching device S has switched over. The switching device S may in this case be controlled by a control device, such as a microcontroller in the mobile radio terminal. The comparison of the actual value act and the nominal value nom, and the control of the transmit amplifier PA as a function of this, are carried out in accordance with the description relating to Figure 1. A development provides for the antenna arrangement to be a dual-band antenna arrangement, which has four resonators, with one resonator in each case being provided for transmitting and receiving in each of the two frequency bands. During transmit operation, the reception resonators are used as coupling elements. The reception resonators are switched over to the receive amplifier LNA and the radio-frequency detector HFD, as described above, by means of a controlled switching device.

Patent claims

1. A method for controlling the power of a transmit amplifier (PA), of a mobile radio terminal,

in which a portion of the power transmitted at the transmission end from an antenna (ANT) of the mobile radio terminal is received at the transmission end by a coupling element (K) of the mobile radio terminal, and is used, at the transmission end, to control the power of the transmit amplifier (PA) of the mobile radio terminal.

2. An arrangement for controlling the power of a transmit amplifier (PA), of a mobile radio terminal,

- having means (K) for receiving a portion of the power transmitted from an antenna (ANT) of the mobile radio terminal, and

- having means (V, PA) for controlling the power of the transmit amplifier (PA) of the mobile radio terminal as a function of this received portion of the power transmitted from the antenna (ANT) of the mobile radio terminal.

3. The arrangement as claimed in claim 2,

in which the antenna of the mobile radio terminal (ANT) is in the form of a planar antenna (ANT1), with the planar antenna having a first resonator (RES1) which is mounted on a substrate (SUB),

in which the means (K) for receiving a portion of the power transmitted from the planar antenna (ANT1) of the mobile radio terminal have a second resonator (RES3), and

in which the first resonator (RES1) of the planar antenna (ANT1) and the second resonator (RES3) are mounted on the same substrate (SUB).

4. The arrangement as claimed in one of claims 2 or 3, in which

means (K) for receiving a portion of the power transmitted from an antenna (ANT) are provided, during transmission operation of the mobile radio terminal, at least partially by means of the receiving antenna of the mobile radio terminal.

GR 99 P 1182

Abstract

Method and arrangement for controlling the power of a transmit amplifier

In order to control the power of a transmit amplifier, a portion of the power transmitted from the antenna is received by a coupling element and is converted via a radio-frequency detector to a DC voltage value which is used for power control. There is no longer any need for complex use of a directional coupler between the transmit amplifier and the antenna.

Figure 1

Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

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I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren und Anordnung zur Leistungsregelung eines Sendeverstaerkers

Method and arrangement for regulating the power of a transmit amplifier

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 01.02.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/00275
eingereicht wurde und am _____
abgeändert wurde (falls tatsächlich abgeändert).

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Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

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Prior foreign appplications Priorität beansprucht			Priority Claimed	
19905731.1 (Number) (Nummer)	DE (Country) (Land)	11.02.1999 (Day Month Year Filed) (Tag Monat Jahr eingereicht)	☒ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

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PCT/DE00/00275 (Application Serial No.) (Anmeldeseriennummer)	01.02.2000 (Filing Date D, M, Y) (Anmeldedatum T, M, J)	_____ (Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
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German Language Declaration

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Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address
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